UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,331,012 B2
APPLICATION NO. : 10/634723
DATED : February 12, 2008
INVENTOR(S) : Bane Vasic et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

At col. 6, lines 28–31, please delete:
"0*(1111111111111111)+1*(0000000011111111)+1*(0000111100001111)+0*(0011001100110011)+ 0*(0000000000001111)+0*(0000000000110011)+0*(0000000001010101)=(0000111111110000)."

and insert therefore:
-- 0*(1111111111111111)+1*(0000000011111111)+1*(0000111100001111)+0*(0011001100110011)+ 0*(0101010101010101)+0*(0000000000001111)+0*(0000000000110011)+ 0*(0000000001010101)=(0000111111110000). --

At col. 8, lines 46–59, please delete:
"FIG. 3 illustrates a communication circuit 10 according to the present invention. The communication circuit 10 includes an RM-encoder 12, a partial-response channel 14, and a Reed-Muller partial response decoder 16 (RM-PR 16). For simplicity, a transmission of a single codeword *m* is shown, though the same principle of operation holds for every message word transmitted. As shown, codeword *m* is input into the RM encoder 12, which generates an RM-encoded codewordx. RM-encoded codewordx is transmitted over the Partial-Response (PR) channel 14, which tends to introduce noise to the codewordx such that the received codewordy contains unknown errors. As shown, the received codeword *y* is input into the RM-PR decoder 16, which produces an output decoded codeword."

and insert therefore:
-- FIG. 3 illustrates a communication circuit 10 according to the present invention. The communication circuit 10 includes an RM-encoder 12, a partial-response channel 14, and a Reed-Muller partial response decoder 16 (RM-PR 16). For simplicity, a transmission of a single codeword *m* is shown, though the same principle of operation holds for every message word transmitted. As shown, codeword *m* is input into the RM encoder 12, which generates an RM-encoded codeword *x*. RM-encoded codeword *x* is transmitted over the Partial-Response (PR) channel 14, which tends to introduce noise to the codeword *x* such that the received codeword *y* contains unknown errors. As shown, the received codeword y is input into the RM-PR decoder 16, which produces an output decoded codeword. --

At col. 9, lines 15–16, please delete:
"The interleaver 18 orders re-orders the RM-encoded codeword *x* prior to passing the codeword *x* to the partial-response channel 14."

and insert therefore:

Signed and Sealed this

Seventh Day of December, 2010

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

-- The interleaver 18 randomly re-orders the RM-encoded codeword x prior to passing the codeword x to the partial-response channel 14. --

At col. 10, lines 42–46, please delete:

"The BCJR or SOVA device 20A has no initial reliability vector $\lambda(\hat{m})$ associated with the received code word y, so the second input of the BCJR or SOVA device 20A is a reliability vector $\lambda(\hat{x})$ of value zero, providing no indication of reliability."

and insert therefore:

-- The BCJR or SOVA device 20A has no initial reliability vector $\lambda(\hat{x})$ associated with the received code word y, so the second input of the BCJR or SOVA device 20A is a reliability vector $\lambda(\hat{x})$ of value zero, providing no indication of reliability. --

At col. 11, lines 34–35, please delete:
"corresponding to G_j (with) message word bits $x_s^{(j)}$ having index s such that"

and insert therefore:
-- corresponding to G_j (with message word bits $x_s^{(j)}$ having index s such that --

At col. 11, lines 50–57, please delete:
"In each array P_s, each column shows the locations of the code bits to be added together to give an estimation of the message bit x_s. This addition is modulo-2 addition. In the hard-coding version, the message bit is determined by a majority vote among all 2^{m-j} estimations, (as described above), and the received code vector is updated according to the relation $y \leftarrow y \times x^{(j)} G_j$, and then passed to the next decoding step (step $j \times 1$)."

and insert therefore:
-- In each array P_s, each column shows the locations of the code bits to be added together to give an estimation of the message bit $x_s^{(j)}$. This addition is modulo-2 addition. In the hard-coding version, the message bit is determined by a majority vote among all 2^{m-j} estimations, (as described above), and the received code vector is updated according to the relation $y \leftarrow y + x^{(j)} G_j$, and then passed to the next decoding step (step j+1). --

At col. 11, lines 62–64, please delete:

"$$LLR(b_s) = \log\left(\frac{Probability(b_s = +1|y)}{Probability(b_s = -1|y)}\right)$$"

and insert therefore:

-- $$LLR(b_s) = \log\left(\frac{Probability(b_s = +1/y)}{Probability(b_s = -1/y)}\right)$$ --

At col. 12, lines 5–32, please delete:

"

$$\mu(\hat{m}_s^{i,j}) = -S_s^{i,j} \cdot \log\left\{-\tanh\left(\frac{A_s^{i,j}}{2}\right)\right\} \quad (1)$$

$$S_s^{i,j} = \prod_l sign\{\mu(\hat{x}_l^{i,j,s})\} \quad (2)$$

where $\mu\left(\hat{x}_l^{i,j,k}\right)$ is the LLR of the expression for the s-th message bit from the i-th equation in the j-th level, and where

$$A_s^{i,j} = \sum_l \log\left|\tanh\left(\frac{\mu(\hat{x}_l^{i,j,s})}{2}\right)\right|. \quad (3)$$

and"

At col. 12, lines 5–32, please insert therefore:

--

$$\mu(\hat{m}_s^{i,j}) = -S_s^{i,j} \cdot \log\left\{-\tanh\left(\frac{A_s^{i,j}}{2}\right)\right\} \quad (1)$$

where $\mu\left(\hat{x}_l^{i,j,s}\right)$ is the LLR of the expression for the s-th message bit from the i-th equation in the j-th level, and where

$$S_s^{i,j} = \prod_l sign\{\mu(\hat{x}_l^{i,j,s})\} \quad (2)$$

and

$$A_s^{i,j} = \sum_l \log\left|\tanh\left(\frac{\mu(\hat{x}_l^{i,j,s})}{2}\right)\right|. \quad (3)$$

--

At col. 12, lines 56–63, please delete:
"In the hard decoding version (Reed algorithm), a message bit is determined by a majority vote, and the received code vector is updated using the expression $\underline{y \leftarrow y \times x^{(j)} G_j}$ given above, and then passed to the next decoding step. In the soft decoding version, prior to advancing to the next row of the decoder **16**, the updated message bit likelihoods must be converted to the code bit likelihoods. This conversion is performed based on the submatrix G_j."

and insert therefore:

-- In the hard decoding version (Reed algorithm), a message bit is determined by a majority vote, and the received code vector is updated using the expression $y \leftarrow y + x^{(j)} G_j$ given above, and then passed to the next decoding step. In the soft decoding version, prior to advancing to the next row of the decoder **16**, the updated message bit likelihoods must be converted to the code bit likelihoods. This conversion is performed based on the submatrix G_j. --

At col. 13, lines 26–27, please delete:
"Suppose that the nonzero positions of the 1-th column of G_j are given by the set {1l ... 1} where"
and insert therefore:
-- Suppose that the nonzero positions of the 1-th column of G_j are given by the set $\{l_l \ldots l_t\}$ where --

At col. 13, lines 63–65, please delete: "
$$\lambda(\hat{x}_l) = \left[\prod_j sign\{u(\hat{m}_{lj})\}\right] \cdot \min_j\{|\mu(m_{lj})|\}$$
"

and insert therefore: --
$$\lambda(\hat{x}_l) = \left[\prod_j sign\{\mu(\hat{m}_{lj})\}\right] \cdot \min_j\{|\mu(m_{lj})|\}$$
--

At col. 14, lines 46–56, please delete: "
$$\begin{aligned} m_{10} &= c_0 + c_1 + c_{2+c3} \\ m_{10} &= c_4 + c_5 + c_{6+c7} \\ m_{10} &= c_8 + c_9 + c_{10+c11} \\ m_{10} &= c_{12} + c_{13} + c_{14+c15} \end{aligned}$$
"

and insert therefore: --
$$\begin{aligned} m_{10} &= c_0 + c_1 + c_2 + c_3 \\ m_{10} &= c_4 + c_5 + c_6 + c_7 \\ m_{10} &= c_8 + c_9 + c_{10} + c_{11} \\ m_{10} &= c_{12} + c_{13} + c_{14} + c_{15} \end{aligned}$$
--

At col. 14, lines 63–66, please delete: "
$$P_{10} = \begin{bmatrix} 0 & 4 & 8 & 12 \\ 1 & 5 & 9 & 13 \\ 2 & 6 & 10 & 14 \\ 3 & 7 & 11 & 15 \end{bmatrix}$$
"

$$P_{10} = \begin{bmatrix} 0 & 4 & 8 & 12 \\ 1 & 5 & 9 & 13 \\ 2 & 6 & 10 & 14 \\ 3 & 7 & 11 & 15 \end{bmatrix}$$

and insert therefore: -- ______________ --

<u>Note that the first column of P_{10} is a set of indices from the first expression (10) above, and the other columns represent sets of indices from expressions (11)-(13).</u>

At col. 15, lines 10–15, please delete: "

$$P_5 = \begin{bmatrix} 0 & 4 & 8 & 12 \\ 1 & 5 & 9 & 12 \\ 2 & 6 & 10 & 14 \\ 3 & 7 & 11 & 15 \end{bmatrix}$$

"

and insert therefore: --

$$P_5 = \begin{bmatrix} 0 & 4 & 8 & 12 \\ 1 & 5 & 9 & 13 \\ 2 & 6 & 10 & 14 \\ 3 & 7 & 11 & 15 \end{bmatrix}$$

--

At col. 15, lines 26–28, please delete: "

$$P_1 = \begin{bmatrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 \end{bmatrix}$$

"

and insert therefore: --

$$P_1 = \begin{bmatrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 \end{bmatrix}$$

$$P_0 = [0\ 1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 10\ 11\ 12\ 13\ 14\ 15]$$

--